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A Multilevel Model of Collaboration and Creativity

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The progress of science requires the growth of understanding in both directions, downward from the whole to the parts and upward from the parts to the whole.
—FREEMAN DYSON, *1996, p. 2*

CREATIVITY DOES NOT occur in a vacuum. An enabling environment must exist. Whether creativity is at the breakthrough level or a cluster of micro-level events, it requires environments with special facets—especially collaboration that enables knowledge sharing and idea synthesis.

Collaboration is a way of working that applies to multiple levels of organization. From teams to joint ventures between corporations, there are multiple similarities across the levels of analysis where collaboration becomes an appropriate choice. The purpose of this chapter is to provide a framework that enables scholars to examine the way collaboration applies across each level and between levels. Each level consists of a system of relationships between people designed to enable them to achieve shared goals. That design is both deliberate and emergent. We might hyphenate those two terms to emphasize their complex oscillating relationship: deliberate-emergent.

When a problem or project requires intellectual, social, financial, technological, or materials resources beyond what the individual, group, or organization as actors at different levels of complexity currently can mobilize, the individuals form relations with peers to leverage resources (Funke, 2010; Hung, 2013). The nature of the relationships that develop between and among individuals, groups, and organizations varies from formal, explicit, and legalistic, to informal, unspoken, and caring. These relationships create links that become part of the socio-intellectual organizational networks embedding the

actors, so valued information and material can flow back and forth to aid in accomplishment of decision making, coordinated action, and creativity.

Among these accomplishments, creativity represents an idea or an action that is both novel as well as useful (Amabile, 1988; George, 2007; Stein, 1974) when the usefulness is actual rather than perceived (King & He, 2006). Between novel and useful lies the ground of actionable knowledge—creating knowledge that can be applied to achieve results (Argyris, 1993). So the foundation of creative work is learning and knowing (knowing what) information or processed data, how (so action competencies are available in the system), and why (so decision making is informed), and finally caring why (so ownership of the decision leads to implementation) (Quinn, Anderson, & Finkelstein, 1996). This trio of criteria defining creativity applies whether the idea is mini-C, Little C, Pro-C, or Big-C, meaning small-scale creative contribution or large (Kaufman & Beghetto, 2009), and then becomes Little-I or Big-I as creativity morphs into innovation at the larger system level (Day, 2007). Creativity is a manifestation of something original that emanates from what is already known, in a way that signifies a new direction. However, it is also critical to acknowledge the utility aspect of that novel idea. Creativity must lead to a path that is useful for multiple stakeholders (and not just for the originators). Collaboration by different stakeholders—in pooling their talents and needs—can lead to creative outcomes that will speak to the deficiencies and hence to the usefulness for all. As this chapter elaborates, collaboration brings in distinct players who contribute such that the *whole becomes more than the sum of the parts*—what we identify as creativity. Thus, it is pertinent to focus on collaboration as a means of complementing both the usefulness and novelty aspects of creativity.

This edited book focuses on the creative work of teams. Teams form the bridges between organizations, industries, and nations that "collaborate" on massive projects. At all levels of working together where the talents and viewpoints of a number of people coalesce to get the work done, the process involves collaboration. An appreciation of the relationship between collaboration and creativity in teams is predicated on an understanding of the multidimensional nature of teams. The team as organizing instrument is tailored to address specific problems and challenges ranging from pharmaceutical research on personalized medicine to assembly of deep-sea, oil-drilling rigs or launch of a rocket to the planet Mars. Challenges of such magnitude usually involve a massive team with many specialized subteams—a multiteam system (Poole & Contractor, 2011) embedded in a larger organizational network. Smaller teams may be used in thousands of other kinds of projects

such as technical sales or hospital emergency rooms or assembly of handcrafted automobiles. This chapter reviews and synthesizes the literature on collaboration because of its central role in the creative work of teams in order to form a multilevel perspective of collaborative activity. Then we propose the framework for a multilevel understanding of collaboration. However, we first start out by explaining the link between creativity and collaboration and why it is critical to study collaboration as an antecedent for creativity in teams.

Creativity and Collaboration

Though creativity can be both an individual and a group construct, there is no evidence to support the proposition that it is essentially an intrinsic concept blossoming only when the individual is left to his own means (George, 2007). For example, Mozart and Beethoven both worked collaboratively with friends who were expert on the violin to create new music that remains popular today, and Newton stood on the shoulders of giants, as he said of his work in physics. In any field, we see how the work of forerunners acts as a foundation for new creative acts or people with shared interests and complementary expertise collaborate to create something new. Creativity is fast being recognized as an ability to see the common thread between different fields of knowledge and use those associations to generate something novel. Not only should that idea, solution, or product be novel, but it should be useful or meaningful to the needs of the individuals. Hence, creativity is relevant only when it is able to fill a gap—address a "distress"—in an organization (Farh, Lee, & Farh, 2010). Within this meaning, creativity can be seen as an outcome that is valued as a solution. However, creativity can also be seen as a process—a cognitive and interactive mechanism through which individuals, groups, or organizations work in tandem to achieve a goal. The underlying thread consists of entities working together—crossing boundaries to create a hybrid of insight and knowledge.

Organizations must adapt to changing environments, so collaboration and creativity must occur across the organization. To explain how group creativity is processed in organizations, we focus on three streams of concepts to explain the connections between collaboration and creativity: (1) network structure, (2) learning, and (3) complexity, as a 21st-century version of sociotechnical systems theory. These three concept sets have been studied extensively and increasingly related to teaming (Edmondson, 2012) and creativity in the literature. They seem to apply across levels.

The theory picture for creativity and teams is quite complicated. For example, the theory zoo includes 25 theories of virtual teams (Schiller & Mandviwalla, 2007), 31 theories of organizations (Hult, 2011), 60 theories of creativity (Greene, 2004), and dozens of theories of learning within five paradigms (Lee, Ng, Rabinovich, & Wu, nd). This proliferation of perspectives in emerging models and theories might be termed "an embarrassment of riches." We will select just a couple of the possibilities for this chapter. Work toward a more unified theory may take another generation of scholarship. For purposes of this chapter, under the section "Networks," we will discuss network theory and organization forms. For learning, we suggest it represents a process based on experience and reflection that results in a richer behavioral repertoire for dealing with the environment at any level of organization. Team knowledge transfer models explain how collaboration leads to learning and creativity. For complexity, we draw on the assumptions of complexity theory to capture the vertical and horizontal interdependence of the parts of organizations and their emergence.

Networks

In the broadest sense, networks represent systems of channels that enable flow of physical substances like water, heat, or electricity and nonphysical substances such as information (Bejan & Merkx, 2007). Flow of information in a team setting enables sharing of knowledge and ideas. Specifically, several factors in the contextual landscape of teams facilitate flow that enables creativity (George, 2007). These factors include (a) signals of safety, (b) creativity prompts, (c) supervisors and leaders, and (d) social networks. Social networks facilitate team members' creativity in multiple ways. For example, research shows that characteristics of individuals' social networks influence creativity, which help to come up with novel ideas (Lin, 1999; Madey, Freeh, & Tynan, 2002), and perspective taking and prosocial motivation in relating to others enrich novel ideas. Research on the relationship between social networks and creativity suggests that network characteristics that promote sharing of diverse information and perspectives increase creativity (George, 2007).

Network theory has been adopted by multiple fields to describe technical, biological, organizational, and social systems. We will focus on the social form of networks but note that the infrastructure of collaborative work usually involves all four types of network systems and their interaction. The model of network performance in organizations was developed based on theories of network structures and emergent networks such as resource-dependence and

related-exchange theories, contagion theories, cognitive theories, and theories of network and organizational forms (Ahuja & Carley, 1999).

Out of the wide range of phenomena described by network theory, three apply in the case of creative knowledge work: social, knowledge, and organizational. Interestingly, three of the forms of intangible capital refer to value generated within those networks: social capital, human capital, and organizational capital. These three interact to provide much of the context of creative work. A common metaphor for networks consists of a fisherman's net with lines knotted together to illustrate nodes and links forming an interconnected whole. However, that metaphor falls short of describing knowledge work in a social network in several ways: First, the social network is multidimensional consisting of both horizontal and vertical links; second, it is in constant change; and third, it is embedded in a complex environment where shifting context changes meaning in unpredictable ways. In knowledge networks, the parts consist of elements of knowledge that become interrelated through individual or group processing, such as facts interconnected to form a model. Over time, the knowledge network grows and changes as old connections are dissolved because of disproof or disuse and new ones are formed from new insights. Organizational networks seem to consist of relatively fixed points in the process of transforming inputs into outputs—a system with cycles, but the mix of the formal and informal organizational structures weaves the social and organizational into a single network through which knowledge flows. This pattern seems to apply at the team, multiteam, and organizational levels.

Some scholars have suggested that social and knowledge networks are isomorphic with similar form (Yayavaram & Ahuja, 2008), so changes in the relationships of the social network are reflected in changes in the knowledge network. Since membership in one of the many social networks in an organization changes through hiring, firing, and transfers, new knowledge becomes available for sharing and new connections can be made. The boundary around a team enables a concentration of resources and a focus of attention but remains porous to outside influences.

A change in organizational structure leads to a change in social connections, which alters the learning and creativity possibilities in the knowledge network. Learning theories and the team knowledge transfer model help with understanding how creativity occurs while collaborating and learning across organizations. More recent theories suggest that learning is situated in work practice rather than on knowledge acquired outside the context of actual work (Brown & Duguid, 1991; Robey, Khoo, & Powers, 2000). The team knowledge transfer model applies to where membership is relatively

stable, but with members having interaction both within the focal team and with the collocated others (Griffith, Sawyer, & Neale, 2003). Growth of the knowledge network represents learning. The learning is expressed in new behaviors, routines, and practices as patterns of action (Pentland, Feldman, Becker, & Liu, 2012), and new knowledge is a prerequisite to effective decision making because the context of the decision, such as the environment, constantly changes.

Westphal, Gulati, and Shortell (1997) define practice as a bundle of behavioral routines, tools, and concepts used to accomplish a specific task. The routines can populate practice at any of the levels of organization. For example, Cisco has established a fairly routine approach to acquisition of new companies. Each decision has the possibility of impacting other people and many decisions require their input, so decisions at all levels of the organization depend on the social network of stakeholders and the knowledge platform they bring or create to inform the decision. Actionable knowledge, learning, and innovation also depend on these interdependent networks. For example, the potential for utilizing the current knowledge assets of a group for innovation and creativity depend on the current interconnections among the knowledge elements through the combinatorial potential of those elements (Carnabuci, 2010), and the quality of social interaction between the members, including psychological safety (Edmondson, 1999) and efficacy (Bandura, 1977).Complexity theory suggests that organizations consist of many interdependent parts operating as a whole and embedded in a larger environment (Anderson, 1999). This concept will be further explored in a later section on "Multilevel Theory of Collaboration."

What Is Collaboration?

"Collaboration" has become a widely used term in the past two decades in both research and practice. As with the term "team," the term "collaboration" is used in a variety of ways depending on context and purpose. The term has referred to both types of relationships and qualities of relationships, including the team level and the corporate level, as a process and as an outcome. Each seems to have a common core meaning related to people working together to achieve a common goal. Such work is never an isolated phenomenon; it is always embedded in a more complex system.

Collaboration is a critical foundation as well as a process for enabling creativity in teams. The term "collaboration" itself can have varying meanings depending on the context of the situation. In this section, we articulate the

meaning of the term. Etymologically, "collaboration" means labor together. However, the concept, theory, and practice have grown quite complex as organizations and organization science have become more complex. Some argue that collaboration has social and emotional dimensions that relate to bonding behavior, which can only be displayed by individuals. However, many of the essential intangibles emerging in groups and teams appear in the cultures of large systems. For example, Scott (2008) defines "institutions" as being "composed of cultural-cognitive, normative, and regulative elements that, together with associated activities and resources, provide stability, and meaning to social life" (p. 48). Those relationships may become collaborative and seem to describe elements of effective teams. A creative and collaborative relationship in teams implies interdependence between members that may be based on such shared responsibilities and outcomes as task, goal, customer, process, or rewards (Beersma, Homan, Van Kleef, & De Dreu, 2013; Hertel, & Orlikowski, 2015; Saavedra, Earley, & Van Dyne, 1993).

How do we connect, communicate, coordinate, cooperate, and finally collaborate? The answer to these five questions includes technical, social, emotional, intellectual, and organizational facets of organization. An effective interpersonal relationship process applied to work on a complex challenge requires good answers to all five questions. The fifth question ("How do we collaborate?") seems to be often omitted, taken for granted, or lumped under one of the other four. For example, collaboration seems to be confused with partnership in some of the literature on joint ventures between companies. Collaboration as a quality of network links (relationships) provides high-fidelity channels for flow of knowledge and is optimized when the members partner in a way that maximizes coordinated action.

Why Bother With Collaboration?

In the absence of a relationship, the individual, group, or organization remains isolated, operating out of a silo, with one-directional communication. This kind of isolation may be a stage in a long process of actions that includes direct and rich interaction, as when an individual or group or organization needs private time for reflection, regrouping, and rethinking the project or the relationships. But if the siloed or myopic (Lazer & Friedman, 2007) stance lasts too long, opportunities for access to resources and leveraging of resources are lost and project success becomes unlikely.

Like a Hubble telescope with a view of the target based on a complex lens that makes the invisible visible, creative processes in a team involve seeing a

problem from putting the parts (members) together well enough so their varied perspectives and expertise coalesce into a unified instrument for visioning (e.g., Baer, Leenders, Oldham, & Vadera, 2010; Cohen & Bailey, 1997; Taggar, 2002; Wooley, Chabris, Pentgadon, Hashmi, & Maolne, 2010). Working in a problem space with limited resources of time, funding, equipment, materials, people, and information and with limited thresholds of understanding presents the challenge of achieving more with less or leveraging the resources. Leveraging the talent the members bring to the situation depends to a great extent on how they decide to work together.

At the organizational level, a white paper from the Cisco technology company (Wiese, 2010) suggests the following payoffs for collaboration: (a) lower cost in such areas as transactions, travel, and waste; (b) higher quality in decision making, products, and customer relations; (c) speed of work cycles, moving products to market, and moving from idea to production; and (d) business agility in faster innovation and more flexible deployment of capacity. Efficiency, effectiveness, improved flow, and leveraging of resources emerge from this approach by Cisco. However, some of the payoffs that appear in the teams literature are missing, including reduced opportunity cost where useful alternatives are not considered, better grasp of the problem or opportunity through synthesis of viewpoints, ownership of the problem that increases motivation and attention to the task, and development of enhanced capability over time. There may even be a more fundamental payoff of greater value: complexification.

Why Collaboration? To Complexify

Adaptation to complex and dynamic environments challenges the team or organization. Collaboration seems to be a central tool for adaptation. Collaboration requires investment—working well together across any boundary on any scale requires preparation, feedback, learning, tradeoffs, and so on, which are only justified when the goal of the effort exceeds what is achievable by any simpler form of organization. For example, advice in industry includes, "Don't use a team when a group can do the job, but don't give work that requires teams to a mere group." A failure to recognize the complexity of the challenge facing the group results in an oversimplification of the problem definition and a subsequent effort that falls short of the goal. The complexity of the group structure (on any level of group scale) sets an upper limit to the creativity of that group in solving the challenges it faces. The law

of requisite variety states that in order for one system to be able to deal with another system, it must have the same or greater complexity (Ashby, 1956). The system must develop the needed complexity and then sustain it, such as protecting diversity of perspective. This seems akin to developing a behavioral repertoire as an individual or organization matures. Developing requisite variety requires complexification and isomorphism. The system must deliberately build the interrelationships that add complexity so it becomes isomorphic with the challenge it faces—a matching of the complexity of the problem-solving resource to the problem. This matching the two kinds of complexity seems related to psychological flow. Csikszenmihalyi (1986) defines flow as the point where the level of challenge is a match for the level of skill. Collaboration becomes possible when the members achieve that level of complex social and intellectual system by developing interdependence. Where does one find the resources, and how does one marshal them in order to tackle a major new challenge? After all, "The pint cannot comprehend the quart," as the old saying goes.

Response to a problem ranges from concrete or stimulus bound and simplistic to abstract and sophisticated, from the single experimental results to the nomological network supporting a theory. The range of response options rises as one moves toward the abstract end of the continuum by learning. Response level to a perceived challenge in the environment may vary by level of adaptability from the following:

1. Reaction or reflex—relying on quick response without thought.
2. Habituated response—relying on stored knowledge and routines and adopting that behavior pattern for efficiency, rather than learning.
3. Creative response—crafting a fit between accessible resources and perceived challenge.

The different conditions and elements in an organization's environment create a pressure for internal differentiation for improving fit. The internal diversity of the organization or the team has to fit the variety and complexity of the environment in order to handle the environment successfully (Ashby, 1956). This assumption is based on the notion of isomorphism, which states that an organization matches and reflects the complexity of its environment with internal structures and systems (Hatch, 1997; Vecchio, 2006). Requisite variety is conducive to organizational adaptivity because it allows the pursuit of multiple courses of action and quick changes from one course to another as the environment changes—a repertoire that can sense and respond to

subtle nuances (Nonaka, Takeuchi, & Umemoto, 1996; Stewart, Mullarkey, & Craig, 2003).

"The cybernetic law of requisite variety notes that the greater the variety of perturbations that the system may be subjected to, the larger the variety of actions it requires to remain in control" (Gershenson, & Heylighen, 2005, p. 7). Globalization has made the environment more complex and more turbulent, so new ways of organizing are emerging for adapting to the challenge. The growing need for adaptability has motivated members of organizations to increase their complexity in ways that enable them to cope with the new challenges, including new forms of collaboration, such as strategic alliances and joint ventures. Table 8.1 lists three levels of problem complexity from a continuum of types and indicates typical response levels needed to develop solutions.

Recently, Bernstein and his associates added the idea of "super-wicked" problems such as climate change that demand a global level of collaboration (e.g., Bernstein, Lebow, Stein, & Weber, 2000; Levin, Cashore, Bernstein, & Auld, 2012). Twenty-first-century organizations need a repertoire of behaviors for working at all the levels of problem complexity and using learning to invent adaptive responses to each. Mature teams display a level of complexity that emerges from effective interaction and that enables them to cope with difficult challenges such as ill-defined and wicked problems. As these teams learn from experience and build a more complex social and intellectual structure, they can better match the complexity of ill-defined and wicked problems. An organization with a similar caliber of complex structures between its member teams can respond more effectively to more complex environmental challenges. Nonlinear problems do not respond well to linear solutions, so

Table 8.1 Three levels of problem complexity and examples of solutions

Type of Problem	Solution Methods	Group & Organization Response	Source
Well-defined	Algorithmic	Routine based on big data analysis	Schildt, 2017
Ill-defined	Heuristic	Adaptive decision strategies	Artinger, Petersen, Gigerenzer, & Weibler, 2015
Wicked	Co-creation	Collaborative complexity	Schneider, Wickert, & Marti, 2017

creative problem solving becomes critical. The central features of the mature team are highly relevant in other organization settings where complexification is prerequisite to making sense of and appropriately responding to complex, dynamic environments.

Defining Collaboration

Definitions are crucial to theory building. A simple meaning of "collaboration" is from the Latin root, "collaborare," meaning "to work together." The definition provided by Wood and Gray (1991) is attractive since it speaks to creativity and collaboration at different levels of an organization. "Collaboration occurs when a group of autonomous stakeholders of a problem domain engage in an interactive process, using shared rules, norms, and structures, to act or decide on issues related to that domain" (p. 146).

The term "collaboration" has frequently been used generically to represent the broad area of communications, but it is used more precisely to represent a high quality of communication process. The process of collaboration involves exchanges between people either face to face or through electronic media that enable sharing of written, spoken, graphic, and data forms of information. The stream of exchanges includes sharing information, asking questions, challenging assumptions, praising good ideas, relationship building, committing to plans of action, shared decision making—all of which are characteristics of a co-creative thought process. But collaboration does not simply refer to the conversations and meetings; it represents a broader field of the quality of the working relationship. At its best, the collaborative process results in original solutions with all participants committed to implementation. In a meta-analysis of studies on successful collaboration, Mattessich, Murray-Close, and Monsey (2001) define collaboration as a mutually beneficial and well-defined relationship to achieve common goals. Such relationships develop over time through investment in the process and trust in the relationships.

History Leading Into Definition

The use of the term "collaboration" to describe important work relationships at any level of analysis is fairly recent. To put things in perspective, the first journal publication using the term was published in 1899. The first year with more than 10 articles published using the term was 1963, according to the Scopus database. The term "collaboration" appeared only about 10 times between 1899 and 1933 in publications indexed in the Scopus database. The

number averaged about six per year for the next 30 years. During the same period a somewhat larger body of literature growing at a somewhat faster pace addressed the dynamics of single teams. Then the publication rate for collaboration began to accelerate at a fairly steady pace, with a significant jump in the 1990s possibly related to the launch of the annual International Conference on Work Teams in 1990 and the public Internet in 1995 and then another very significant jump since 2010 perhaps relating to globalization. Disciplines as diverse as physics, social sciences, engineering, and computer science are at the forefront when it comes to studying collaboration, perhaps suggesting that there may be important differences in the meaning of fundamental terms and ideas, including the term "collaboration."

Confusion increases about the term "collaboration" because of the variety of purposes it serves. For example, the term "collaboration" seems to be used in journals in the field of physics in four ways:

1. Authorship—referring to a group of authors
2. Articles on network behavior, Internet architecture, and human–computer interaction
3. Announcements of awards to scholars
4. A technical term describing the way some forces or subatomic particles interact

Other fields have multiple uses as well. Even when focused on the way people work together, there is a multiplicity of meanings for the term "collaboration." The application of the term to multiple levels of analysis ranging from two people to corporations to nations creates confusion—unless one infers from the fact that interaction of people is involved at each of those levels.

Though the term seems to have described the quality of interpersonal relationships in the early literature, its use expanded to describe the relationships of groups and organizations in the past decade or two.

Current Trends in Defining "Collaboration"

Interestingly, a recent use (or misuse) of the term "collaboration" representing an old practice is "mass collaboration." Current, widely known examples include the online encyclopedia Wikipedia.com, the software language Linux, and the Galaxy Zoo, which consists of amateur astronomers (Nielsen, 2012). Examples from prior generations includes the *Oxford English Dictionary* created in the 19th century; the *Encyclopedia of World Problems*

and Human Potential, begun in 1972; and Project Gutenberg (Tovey, 2008). However, in spite of the value these cooperative efforts generated, we do not consider these to be examples of collaboration but rather loose networks. Crowdsourcing and collective intelligence, patterns of cooperative behavior identified in the past decade, also seem to represent loose networks; however, here high-quality collaboration processes emerge accidentally rather than deliberately.

When a collaborative system emerges, relationships are formed between people with similar concerns that enable communication to start flowing. As the relationship quality increases to optimize open sharing, bandwidth for the flow increases (Bejan & Merkx, 2007). A set of relationships characterized by the evolution of such flow capacity takes on network features and may be described by the concepts of social network analysis, such as centrality and social holes. The networks between members of a single team (e.g., Balkundi & Harrison, 2006; Joshi, Labianca, & Caligiuri, 2003; Klein, Lim, Saltz, & Mayer, 2004) and to some extent sets of teams have been well described in literature (e.g., Kratzer, Gemünden, & Lettl, 2008; Marks, DeChurch, Mathieu, Panzer, & Alonso, 2005). Networks along the supply chain between corporations involved in joint ventures, and between universities, companies, and governments, have recently received increasing attention. These examples of network arrangements vary in complication and perhaps complexity but not in fundamental principle. Complexity can take both horizontal and vertical form in social systems. Our intent is to identify the principles that operate across those levels to enable collaboration for the purpose of creative knowledge work.

When collaboration is defined as the highest quality level of interaction for team discovery and creative problem-solving work, it sits at the top of a pyramid of interaction levels as depicted in Figure 8.1. Isaacs's (1993) definition of "dialogue" seems to address the nature of collaboration—"a sustained collective inquiry into the processes, assumptions, and certainties that compose everyday experience" (p. 25).

Figure 8.1 represents all the ways people work with each other. We reserved the top of the pyramid for collaboration because it is most difficult, most rare, and perhaps adds most value compared to the other levels. One person or one team may be involved in most or all of the seven levels shown in Figure 8.1 during a single project and sometimes on the same day. It is imperative that we acknowledge the multilayered nature of collaboration. Similarly, creativity will be that much richer if it seeks to source itself from diverse levels in an organization. The next section explores this proposal.

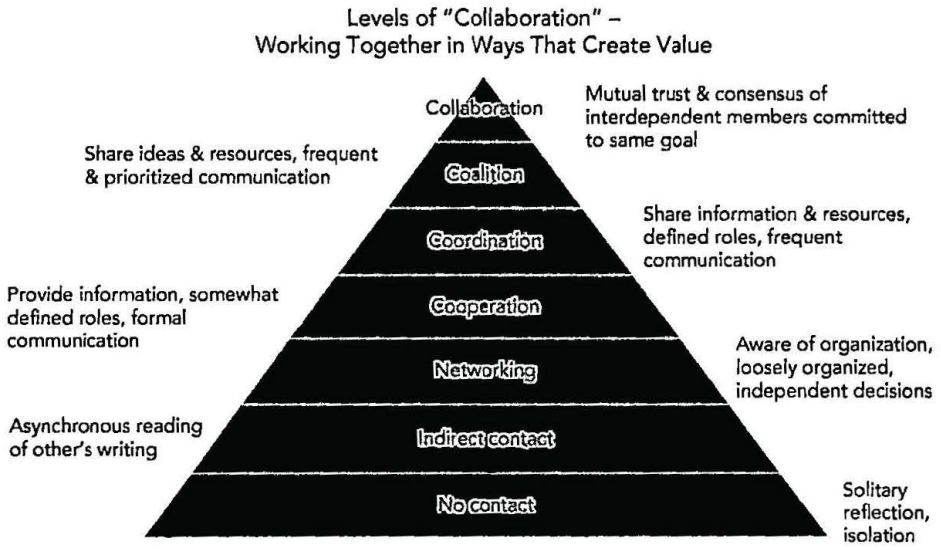

FIGURE 8.1 Levels of "collaboration." (Adapted from Beyerlein, 2011.)

Collaboration at Different Levels of Organization

Collaboration across levels of organization has some aspects in common. First, it is a way of working designed to optimize the flow of ideas and information through open sharing. Second it aims at synergistic perspective on the meaning of the challenge and on the goal. Finally, it generates an ownership of the problem and the solution such that implementation of action steps follows naturally from the analysis and planning. Collaboration is an attempt to complete that "whole" by bringing in different members (individual, teams, organizations, etc.) to achieve something that is valued by all. The members have their expertise and identities—hence their role in the process—to supplement what is otherwise lacking.

Some authors see collaboration as simply the interaction between individuals, whereas others discuss collaborations on departmental or institutional levels (e.g., Hu & Racherla, 2008, p. 304; Stokols, Misra, Moser, Hall, & Taylor, 2008, pp. 97–99). A multilevel view of collaboration seems most defensible under two conditions:

1. The team and multiteam systems are embedded in a hierarchy of systems with vertical interdependence.
2. The definition of organization has changed over the past couple of decades so the differentiation from team has grown fuzzy (e.g., organization as a system of distributed cognition or of distributed attention in Ocasio, 1997, or the use of "teaming" by Edmondson, 2012).

The variety of organizational forms that rely on collaborative relationships includes teams, multiteam systems, projects, programs, platforms, networks, and so on at different levels of work activity (Lerch, Provan, & Sydow, 2008). At a more macroscopic level, Maruo (2000, pp. 41–42) identifies 14 kinds of alliances: mergers, acquisitions, strategic shareholding, joint ventures, national R & D partnerships, limited strategic partnerships, intergovernmental cooperation, consortia, partnerships, coalitions, alliances, supply chains, joint ventures, and federations (Holst, 2000). At all these levels people have agreed to work together toward a common goal (Feighery & Rogers, 1989). Collaboration across these complex organizational arrangements often depends on establishing creative arrangements where bridging the silos enables leveraging of resources.

Because of the complex interdependencies that emerge at each level of collaboration, it might be useful to consider them as nested ecologies (Bartelt, 1994). The multiple levels have a number of common features including social networks (Westaby, Pfaff, & Redding, 2014); system dynamics, including routines evolving with mutual agreement (Oliver, 1997); goals involving creating, accessing, and utilizing knowledge; learning; horizontal and vertical interpersonal relationships; commitment to work in concert; ownership of the process and potential for moving from a state of nonorganization to a higher level of organization; and ultimately a complex system capable of responding to complex challenges.

We will now systematically look at each "level" in an organization at which collaborative interactions exist, starting with a team. A "team" can be comprised of individuals (as in work teams), constituent teams (multiteam systems), and even organizations (e.g., joint ventures). George (2007) describes the individual level as molecular and the team level as molar. Building on that metaphor from chemistry, we suggest the organization as a compound and the embedding system as a mixture, but we recognize that the organic unity of an ecology is lost in that variation of the metaphor. Thus, understanding collaboration involves an appreciation of the multifaceted nature of teams and the key dimensions of effective cooperation that have been identified in research and in other chapters in this book.

The most basic version of a team is a dyad. Creativity often is a product of two individuals bouncing ideas off each other. A dyad is a form of collaboration where two individuals interact to attain a common goal. Literature on dyads offers useful insights on how interpersonal processes can lay the foundation of teamwork (e.g., Sparrowe & Liden, 2005). In dialogue, they strive to create a hybrid perspective that reframes the challenge to produce new

alternative responses—new ways of seeing emerge capable of, producing new options for action. This emphasis finds its basis in social exchange theory.

One facilitator of process in collaboration is the extent to which a member feels that his or her identity (in terms of perceptions of own strengths and weaknesses) seems confirmed and respected by the dyadic roles and interactions (Milton & Westphal, 2005). Thus, collaboration entails a shared understanding of not just the goals of the group but what the members bring (or do not bring) to the table for any of the levels of organization. A recognition and acceptance of an individual's abilities and gaps can serve to complement the other individual's skill set and hence provide a holistic landscape for creativity. Dyadic relationships can influence overall team cohesion. If the relating process between any two individuals is not conducive to coordinated performance, it can easily spiral into a larger dimension where the bigger group feels constrained (De Jong, Bijlsma-Frankema, & Cardinal, 2014).

The impact on performance may be due to distracting attention from the real work of the team or creating siloes within the team—subgroups whose efforts and talents are no longer aligned. Mechanisms that can help restore collaboration initiated at the level of team leadership can be useful to mitigate dyadic problems. These mechanisms can be aimed at increasing the density of member exchange, and realization of task interdependence can again help foster cohesion. Thus, dyadic-level dynamics cannot be ignored if one wishes to appreciate the true nature of collaboration. For example, the smooth operation of a global supply chain can depend on a chain of effective dyads globally distributed as much as it does on the legal contracts that describe agreements between the companies.

In discussing multilevel collaboration, we are implicitly describing people connecting with each other across boundaries—vertical or horizontal. The development of the Internet has enabled new ways to connect across boundaries, and globalization of the economy has created an urgency motivating those connections. Virtual teams represent one form of those connections that create opportunities for bringing multiple perspectives together to enrich thinking about options (Beyerlein, Prasad, Cordas, & Shah, 2015; Harrison & Klein, 2007; Lurey & Raisinghani, 2001).

Cross-functional teaming also depends on crossing of boundaries where team members come from different disciplines. Complex problems require input from multiple disciplines. Such teams bring experts and perspectives together so that comprehensive information is available for robust decision making. Though desirable in principle, cross-functional teams also require some adaptations before they can collaborate effectively (Funke, 2010; Hung,

2013; Jassawalla & Sashittal, 1999). Members of such teams need to unlearn old approaches and learn some new behaviors before creative capability can blossom. Primarily the members need to be mindful of diverse viewpoints and ways of thinking, which may seem as difficult as learning a new language. This disciplinary empathy is critical for establishing synergy in cross-functional teams. The need for shared understanding of the common goal provides a strong foundation for such teamwork. Projects at higher levels of analysis such as joint ventures and mergers rely on cross-functional teams as bridges between the participating organizations.

Multiteam systems (MTSs) represent a complex combination of different teams coming together to achieve a common purpose—teams of teams focused on knowledge intensive work, like a focused version of the team-based organization (Harris & Beyerlein, 2005; Mohrman, Cohen, & Mohrman, 1995). This is a metalevel concept where the constituents are teams working together resulting in complex processes. They can span organizational boundaries. For example, emergency response teams can be composed of members representing the police, fire department, emergency medical technicians, and so on. Research has shown that for MTSs, quality of between-team processes is more critical than within-team processes (Marks, DeChurch, Mathieu, & Panzer, 2005). Edmondson (2012) contrasts two teams of specialists working together under stress in emergency rooms—those that rely on hierarchy and control and those that collaborate. She calls the latter teaming, but her meaning seems quite compatible with our definition of collaboration. In each of the emergency rooms, individuals are contributing their specialized knowledge from defined roles within a system of shared processes toward a common goal. Their attention is focused on the patient and the coordination of team activities and the achievement of professional standards.

Communication, coordination, cooperation, and finally collaboration occur as the members of the ER team contribute their expertise, activity, and insight to the team's effort to help the patient. There is a focusing of attention and an alignment of effort in a temporary arrangement governed by a larger system of roles and expectations. Every patient case is unique, so creativity manifests in adapting standardized procedures to individual needs. The members of that ER team will be working with other teams during the week. Grabher (2002) refers to that situation as temporary collaboration. The team members as a whole focus their attentional processes on the primary tasks for patient safety and smooth teamwork. Collaboration becomes a way of working that fits with the larger culture. The risk of process loss from having a physician controlling the process in an authoritarian manner is the failure

of the team to collaborate and so a debilitation of the open sharing process that enables input from each member to be added to the growing synthesis of shared understanding that makes the probability of finding creative solutions.

Finally, collaboration can be at the level of organizations where two or more constituents form a joint venture or merger. In this era of globalization, companies decide to expand by combining their operations with an entity that is sometimes very different from them. There are instances where such collaborations have failed due to failures of the firms to develop an understanding of the differences inherent in the coming together of any two systems. One example often cited in this respect is the failed merger of German Daimler with the American Chrysler in the 1990s (Scott & Miller, 2000). Of the many reasons examined for the failure, a key was the difference in the organizational culture of the two companies.

Collaboration has been increasingly adopted as a method of developing complex projects. For example, in 2013, the European Commission launched EUWIN: EU Workplace Innovation Network to unite researchers and practitioners in building high-performance workplaces. The academic leaders of the Network's development argue that workplace innovation is the fifth element for creating more effective organizations and communities. The other four elements emerged over the past century: work organization; organizational structure and systems; learning, reflection, and innovation; and workplace partnership (Totterdill, 2015). The emphasis seems to be employee engagement in an enabling culture. Dhondt and Van Hootegem (2015) who manage the Network argue that national-level innovation capability depends on workplace innovation ($r = .63$).

Collaboration across different levels is not easily accomplished. Researchers have noted that bridging between levels is difficult cognitive work (Goldstone & Wilensky, 2008). Resnick and Wilensky describe how mindset can interfere with conceptually bridging the levels—deterministic-centralized mindset (Resnick & Wilensky, 1993; Wilensky & Resnick, 1999). This mindset may be an example of using archaic mental categories to make sense of newly visible phenomena as when old paradigms linger and misinterpret new findings (Kuhn, 1996). However, a similar problem occurred with eighth graders before teaching them to look differently enabled them to see the higher level system as an emergent dynamic equilibrium (Jacobson & Wilensky, 2006). Understanding the relationships among the parts rather than focusing on the parts themselves represented a shift in perspective from novice to expert (Chi, Glaser, & Rees, 1981; Fischer, Greiff, & Funke, 2011). Increasingly, research in multiple fields suggests complex social systems, such

as organizations, function as emergent networks characterized by dynamic equilibrium. Historically, both the recognition of the interdependence of the social and the technical systems in sociotechnical systems theory and the expansion of teams research to multiteam systems represent examples of an emergence of more sophisticated understanding of complex social systems. A systems theory lens provides a holistic picture of the interdependent parts forming a whole (Katz & Kahn, 1978). In the case of a multilevel system, the wholeness applies both horizontally and vertically to account for interdependence in both directions.

Multilevel Theory of Collaboration

Based on the arguments in the paper, where we discuss the nature of collaboration and the theoretical underpinnings, this section focuses on presenting the four core infrastructures that comprise a collaborative environment—as depicted in Figure 8.2. These resonate with the fundamental premise of the sociotechnical approach as well. This representation of sociotechnical systems theory applies to all levels of organization addressed in this chapter wherever interdependence provides structure to the work process. The levels differ in complicatedness and probably in complexity (interdependence) and in scope of goals and operations and need for resources. In many other ways, they will be alike. Figure 8.2 (adapted from Beyerlein, 2011) shows a sociotechnical systems diagram with the soft infrastructure subdivided into the key facets

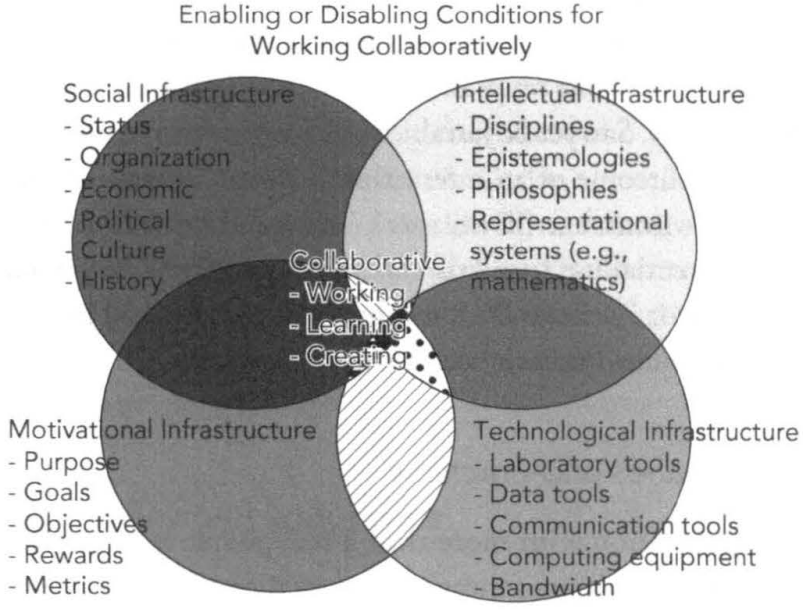

FIGURE 8.2 An elaboration of the sociotechnical systems theory model.

of social, intellectual, and motivational components. The important part of this Venn diagram is the overlapping area in the middle—that is where the resources come together to use a collaborative process to do new creative work. Here we find new ways of working together, learning, and creating in pursuit of shared goals as creative work.

The four-part figure gives some impression of the complexity of the work environment where collaboration may be attempted. At the center of the figure, collaborative working, learning, and creating become possible—when the factors within the four circles have been addressed appropriately. Case examples from literature and practice show that nearly every factor can divide people as well as unite them. For example, under Technological Infrastructure, use of differing computer platforms can impede effective virtual collaboration from occurring, and under Intellectual Infrastructure, assigning members from multiple disciplines to the team can create a Babel of disciplinary languages that demands collaborative invention of a lingua franca.

We divide these perspectives into four broad groups in Figure 8.2 and propose that effective collaboration involves a resolution and/or an acceptance (harnessing) of the issues that are common across the levels that may be intrinsic qualities of the constituents. The groups represent four infrastructures—*motivational* (involving the individual needs and how collaboration could help meet those), *social* (the social, cultural, and organizational environment that an individual exists in and that shapes his or her perceptions and thought processes), *intellectual* (formal and established body of knowledge like disciplines that have systematically grown over a period a time and represent collective knowledge) and finally the *technological* infrastructure (representing synchronous and asynchronous electronic tools used for effective teamwork). These four categories find resonance in the paradigm of the sociotechnical systems theory (e.g., Sawyer & Jarrahi, 2014), which proposes that endeavor is essentially an outcome of an interaction between human and nonhuman aspects of the environment (Trist, 1981). The nonhuman component is susceptible to differential use based on individual proclivity (Osiurak, Jarry, & Le Gall, 2010), so it is essentially a mechanical tool that had been employed by human participants for their use.

Multilevel Routines and Practices

A modern organization with more than a few people is a complicated and complex system (complicated means there are many parts, whereas complex means the parts are interdependent). The major parts of the whole system

act as embedded subsystems. All the subsystems have a number of features in common, including:

1. Dependence on human capital (Cascio & Boudreau, 2012)
2. Network structure of the people relating to each other and network structure relating their knowledge (Carnabuci & Bruggeman, 2009)—a community of knowers interacting with their environments co-creating meaning and acting in concert to achieve shared goals and generate social and intellectual capital (Nahapiet & Ghoshal, 1998) providing input into the subsystems, channels for flow, and embodiment of new value created.
3. The need for trust between contracting parties at any level ranging from dyads up to large construction projects (Gad & Shane, 2011; Xu, Bower, & Smith, 2005). For example, recent developments in project delivery methods and support systems in large construction projects seem to be more effective at maintaining high levels of trust than traditional methods.

Thus, we offer collaboration as a way of working together in small or large groups briefly or across time that is informally agreed upon but may be expressed in formal statements as a norm or goal, usually an implicit agreement on how to share openly for mutual advantage where one party is committed to the success of the other. This definition seems to fit all levels where collaborative behavior can be observed in organizations (dynamic network theory—DNT) (Westaby, Pfaff, & Redding, 2014).

Intangibles play an important role in collaborative situations. The utilization of the intellectual capital members possess is enhanced when social, relationship, organizational, and other forms of intangible capital also develop. For example, in social network analysis (SNA), a position of influence can be evaluated by the following formula: (who you know) × (what you know) = centrality score (Ashworth & Carley, 2006; Lazer & Friedman, 2007). However, in a collaborative situation other factors should be considered, such as (how you communicate), (how you build trust), and (how you work to develop the relationship over time). These five factors and more seem to apply in all of the collaborative situations irrespective of the organizational level from dyads to mergers.

A Model of Behavioral Robustness

At each level of organization, human beings interact to share knowledge and information, make decisions, and coordinate actions for achieving goals.

These essential activities result from patterns of behavior that are robust in the face of change and uncertainty and that simultaneously create stability and change. A convergence of forces creates a robustness of behavior at each of the levels. The forces range from the formal to the informal and work together to create and maintain channels for flow of knowledge and information. The flow enables knowledge to be created (Nonaka, 1994). The knowledge belongs to individuals who have the choice to share it and the choice to convert it to action. Knowledge flows through the relationships created by the organization's members (Kogut & Zander, 1992; Spender, 1996). For example, an extensive literature describes the bipolar challenge of balancing exploitation and exploration. Li, Li, and Liu (2012) refer to this polar relationship as a nonlinear duality of learning. Each pole represents a creativity strategy designed to produce valued outcomes that benefit participants.

Figure 8.3 depicts the range of agreements from formal such as contracts to informal such as norms that correspond with the stability of homeostatic systems and the oscillations of homeodynamic systems. We refer to it as the Behavioral Robustness Cube to indicate that the forces and influences arrayed across the diagram work somewhat in concert to produce predictable behaviors at varying levels of the organization, particularly collaborative behaviors. Figure 8.3 is considered to be a model—an oversimplification of a complex reality containing a number of variables that interact to produce the behavioral phenomenon of interest. Homeostasis represents a steady state for the system, providing a sense of stability and predictability, whereas

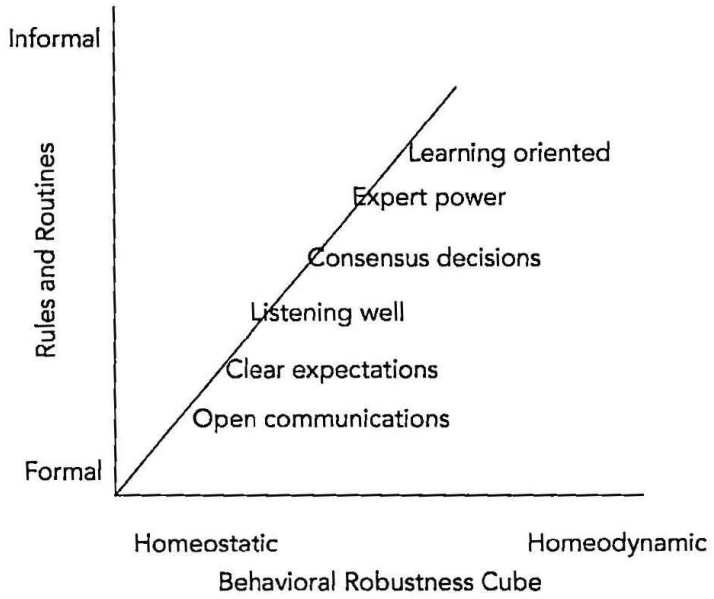

FIGURE 8.3 Enabling environment for collaborative process.

homeodynamics represents a stable pattern of constant change (Deacon & Koutroufinis, 2014; Fernandez-Leon, 2014), such as a standing wave in a rapidly moving river. For example, Elkus (2010, p. 55) describes military operations as though it were homeodynamic, "Like a living organism, a military organization is never in a state of stable equilibrium but is instead in a continuous state of flux—continuously adapting to its surroundings." Continuously adapting indicates that creativity is a continuous process.

Summary and Conclusions

This chapter has attempted to provide a framework for considering teaming and creativity as processes of multilevel collaboration. The context for a novel and useful creative act that generates actionable knowledge consists of a complex multilayered system with multidirectional forces that influence the members' behaviors.

Collaboration and Performance

Many factors play a role directly or indirectly in determining the level of performance of the organization. Some aspects of the relationship between collaboration and performance were mentioned earlier. We will focus on three here that seem especially pertinent to 21st-century companies in a globalized environment: environmental change, the interrelationship of creativity and innovation, and emerging innovation cultures.

First, factors such as globalization and technological change have created both challenges and opportunities for organizations to find new ways to create value for their stakeholders. The more complex the challenge or opportunity, the more essential collaboration becomes at all levels of organization.

Second, the creativity–innovation link represents a path of learning and inventing that produces valued outcomes or new pathways for continuously generating them. These pathways can be generated at any level of organization and woven together to craft a culture that enables proactive and adaptive action.

Third, developing the knowledge, skills, and habits that generate new rules and routines of behavior in the organization through enhanced network structures, useful learning, and growth of complex interdependence to match the level of challenge will enable an innovation culture to emerge, perhaps in isolated pockets first and then spreading across the organization. Zahra and George (2002) defined two different types of absorptive capacities

that seem to fit here: potential and realized. Their new definition of absorptive capacity is: "a set of organizational routines and processes by which firms acquire, assimilate, transform and exploit knowledge to produce a dynamic organizational capability" (p. 186). These apply at all levels of organization from individual up to multicorporate entities when the behavioral patterns become robust.

Summary

Collaboration is a way of organizing when the creative challenge exceeds the capability of an individual or a group that lacks interdependence. The level of challenge dictates the required level of complexification of the group. We usually refer to a complexified group as a team, but the behavior of effective teams shows up in a variety of settings and levels, so teaming (Edmonson, 2012) or collaboration represents complex interdependent work that can cross boundaries horizontally or vertically. Complexification is prerequisite for the teaming system to comprehend (learning and knowing) and respond (actionable knowledge) to the complex challenge—a multifaceted, ambiguous, and dynamic problem or opportunity that requires joint creative work. The quality of that work depends on features of the collaborative system such as open sharing, rapid learning, joint accountability, shared goals, common meaning, and a positive attitude. The identified challenge will be embedded in a larger system or context that is dynamic and that enfolds subsystems characterized by complexity, so the teaming group must operate at multiple levels to have any hope of an optimal solution. The collaboration should be both horizontal and vertical within the organization. Purser and Pasmore (1992) described the work of new product development teams as "building the boat while going downriver." We suggest it is somewhat more challenging a quarter century later as the world of work has become globalized and the pace of change dizzying, so the newer context for creative collaboration becomes—"inventing the paddle, training the rowers, and building the boat, while going downstream in whitewater and managing the ecology of the stream."

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